HONEYWELL

INSTRUCTIONS

R7161C
VERSA-GUARD*
HIGH LIMIT CUTOFF

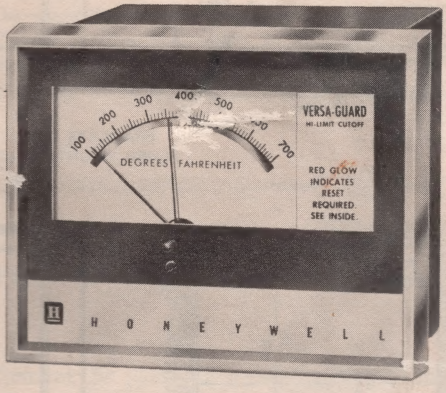
APPLICATION

The R7161C is a high limit cutoff used with a thermocouple sensor to shut down a process if a critical temperature is reached. Manual resetting of the device is required after any shutdown, safety shutoff, or power interruption.

FEATURES

The hinged door assembly contains a readout meter for continuous indication of the actual sensor temperature. When the indirect lighting in the door assembly shows red, it indicates the process condition has exceeded the setpoint, and safety shutoff of the controlled equipment has occurred. Green illumination of the scaleplate indicates safe operation below the high limit cutoff point.

Safety and reliability are achieved by the self-supervising features of the circuitry, including built-in protection against thermocouple burnouts. All major components such as transformers, relay coils and transistors are electrically supervised so that failure or malfunction of any of these parts automatically shuts down the controlled equipment.



The circuit is completely solid state. The only moving parts in the controller are the armature on the control relay, the chopper blade, and the indicating pointer on the meter.

SPECIFICATIONS

MODEL: R7161C Versa-Guard High Limit Cutoff.

SIGNAL SOURCE: DC millivolts.

VOLTAGE AND FREQUENCY: 120/208/220/240 v, 60 cps; Voltage is field selectable. Satisfactory operation is provided between 85 percent and 110 percent of rated voltage. If unit is supplied from a constant voltage transformer, use a harmonic neutralized type only.

INDICATION ACCURACY: ± 1 percent of full scale.

CONTROL POINT REPEATABILITY: ± 60 microvolts.

AMBIENT TEMPERATURE: 40 to 120 F.

SWITCHING ACTION: Spdt, non-overlapping.

RELAY DIFFERENTIAL: 40-120 microvolts.

CONTACT RATINGS: 50 va at 120, 208, 220, or 240 vac with inrush not to exceed 500 va. 50 va at 24 vac with inrush not to exceed 250 va. 5 amp resistive load.

WIRING KNOCKOUTS: Four combination knockouts for 1/2-in. or 3/4-in. conduit, two knockouts for 1/2-in. conduit only.

MOUNTING: Flush, by two brackets on the sides of the case, or surface by screws through four holes in the back of the case.

DIMENSIONS: See Fig. 1, page 2.

TYPICAL RANGES AND THERMOCOUPLES:

Range (F)	Thermocouple	
	Type	Materials
0 to 800 0 to 1200 0 to 1600 100 to 700	J	Iron, Constantan
0 to 2000 0 to 2400	K	Chromel, Alumel
0 to 3000	R	Platinum, Platinum-13 percent Rhodium

WHEN ORDERING:

Specify—
1. Model number.
2. Voltage and frequency.
3. Range and type of thermocouple to be used.

Order from—
1. Local Honeywell Branch Office, or
2. Honeywell Inc.
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422
   (In Canada—Honeywell Controls Limited
   Vanderhoof Avenue, Leaside
   Toronto 17, Ontario).

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Rev. 5-64 V. L.

Form Number **95-5938**
Apparatus Controls Div.

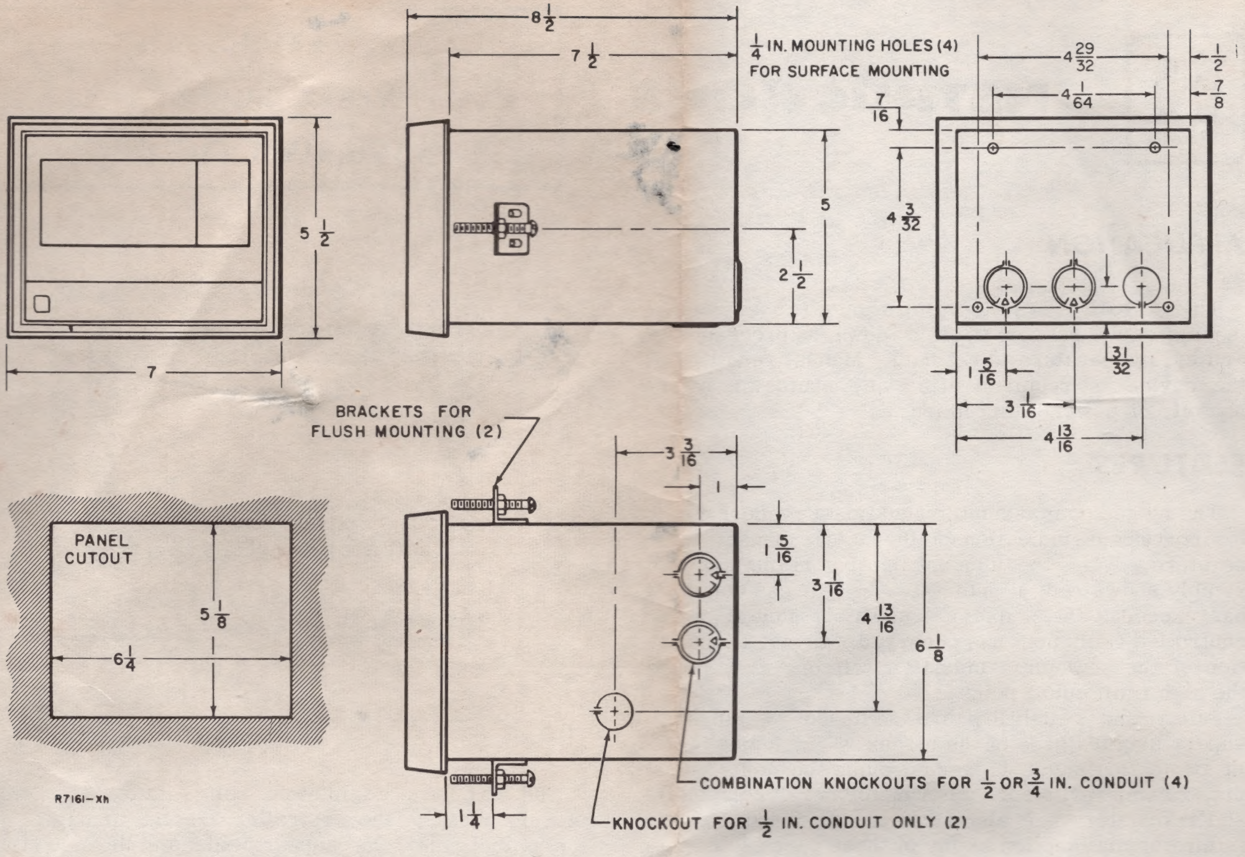

8 1/2
7 1/2
1/4 IN. MOUNTING HOLES (4) FOR SURFACE MOUNTING
4 29/32
4 1/64
1/2
7/8
7/16
4 3/32
5 1/2
5
2 1/2
7
1 5/16
31/32
3 1/16
4 13/16
BRACKETS FOR FLUSH MOUNTING (2)
3 3/16
1
PANEL CUTOUT
5 1/8
6 1/4
1 5/16
3 1/16
4 13/16
6 1/8
COMBINATION KNOCKOUTS FOR 1/2 OR 3/4 IN. CONDUIT (4)
KNOCKOUT FOR 1/2 IN. CONDUIT ONLY (2)
1 1/4
R7161-Xh

Fig. 1

INSTALLATION

MOUNTING:

To protect the finish, leave the protective tape on the door frame until the installation is complete.

1. Open the door. It is hinged on the left and held closed by magnetic attraction only.
2. Remove the packing insert.
3. Snap the indicating lamps out of their sockets.
4. Remove the leadwires from the meter terminals.
5. Remove the two chassis screws and loosen the ten captive screws (which also serve as electrical connections).
6. Carefully pull out the chassis. Put it aside in a safe, clean place while mounting the case.
7. For surface mounting, use the four holes in the back of the case to fasten to a vertical surface.
8. For flush mounting, install case in panel or wall cutout. Add a bracket (supplied) to each side of case.

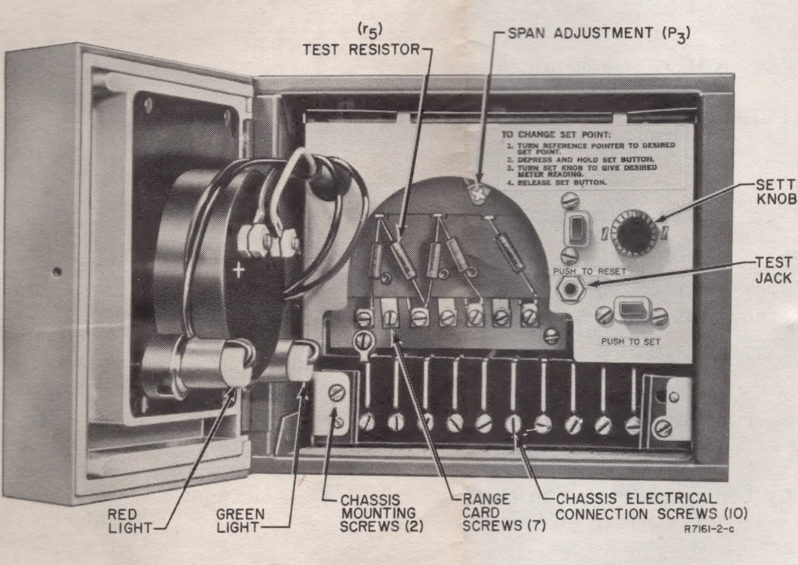

(r5) TEST RESISTOR
SPAN ADJUSTMENT (P3)
TO CHANGE SET POINT:
1. TURN REFERENCE POINTER TO DESIRED SET POINT.
2. DEPRESS AND HOLD SET BUTTON.
3. TURN SET KNOB TO GIVE DESIRED METER READING.
4. RELEASE SET BUTTON.
SETTING KNOB
PUSH TO RESET
TEST JACK
PUSH TO SET
RED LIGHT
GREEN LIGHT
CHASSIS MOUNTING SCREWS (2)
RANGE CARD SCREWS (7)
CHASSIS ELECTRICAL CONNECTION SCREWS (10)
R7161-2-c

Fig. 2—View of R7161C With Door Open.

WIRING:

All wiring must comply with applicable codes, regulations, and ordinances. Use #14 TW single conductor wire.

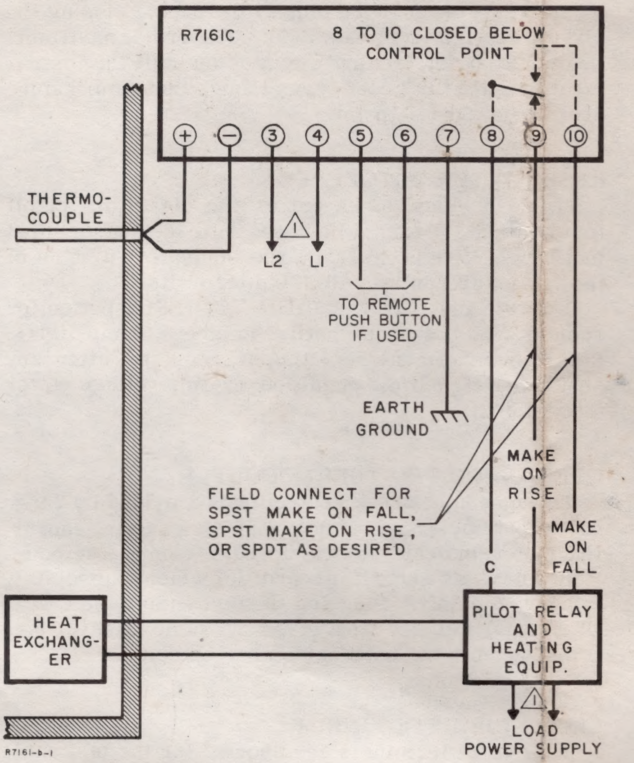

R7161C
8 TO 10 CLOSED BELOW CONTROL POINT
+
−
3
4
5
6
7
8
9
10
THERMO-COUPLE
L2
L1
TO REMOTE PUSH BUTTON IF USED
EARTH GROUND
MAKE ON RISE
FIELD CONNECT FOR SPST MAKE ON FALL, SPST MAKE ON RISE, OR SPDT AS DESIRED
MAKE ON FALL
C
HEAT EXCHANGER
PILOT RELAY AND HEATING EQUIP.
LOAD
POWER SUPPLY
R7161-B-1

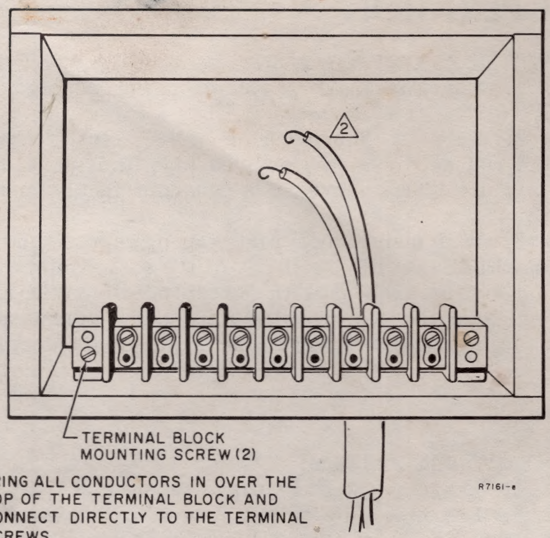
Fig. 3—Typical Connections.

⚠1 Power supply. Provide disconnect means and overload protection as required.

Connect the wires to the appropriate screws on the terminal block. NOTE: Two captive screws are used to hold the terminal block. The block may be removed for ease of wiring if desired (See Fig. 4). The wires must be pressed down tightly against the terminal block and hooked directly to the terminals without using wiring tangs. Carefully position the extra wire in the bottom of the case.

The total resistance, that is, the sum of the resistances of the positive wire and the negative wire, of the thermocouple extension leadwire should not exceed 20 ohms. Higher total resistance in this circuit will result in some loss of control sensitivity. For example, the resistance of 135 feet of #16 gage iron-constantan wire is 20 ohms.

Special precautions should be taken to see that the thermocouple leadwires do not closely parallel line voltage wiring. Fig. 3 illustrates a typical system employing the R7161C Controller.



⚠2 BRING ALL CONDUCTORS IN OVER THE TOP OF THE TERMINAL BLOCK AND CONNECT DIRECTLY TO THE TERMINAL SCREWS.

Fig. 4—Terminal Block.

Thermocouple leadwire has a definite polarity. One wire is positive and the other wire is negative. Thermocouple leadwire supplied by the Apparatus Controls Division of Honeywell is always identified for polarity by red insulation on the negative (-) wire. Be sure the proper thermocouple extension leadwire is used for the right type of thermocouple and instrument calibration and that the polarity of this wire is properly identified.

CHASSIS

A. Before re-installing the chassis in the case, check the voltage selector terminals—

1. Turn the chassis upside down. Remove the small nut and wiring shield for access to the transformer.
2. The voltage selector terminals are "quick connect" taps on the transformer. Be sure the single leadwire is connected to the tap matching the supply voltage.
3. Re-install the wiring shield.

B. The factory ships the R7161C completely calibrated for the range and thermocouple specified in the order. Caution: Do NOT attempt to reset adjustable potentiometers P_1, P_2, P_3 until re-calibrating is required for a range change or possible malfunction.

1. Re-install chassis in the case. Start all ten captive screws to get proper alignment, then add the two chassis end screws.
2. Connect the meter leads, red to the (+) terminal.
3. Snap the lamps into the matching color coded sockets.

OPERATION

SET THE CONTROL POINT:

1. Energize the line voltage power supply to the R7161C.
2. Turn the knurled knob on the meter face to set the red needle at the desired high limit cutoff temperature. This serves as a constant visual reference point.
3. With meter door partly open, depress and hold the PUSH TO SET button. At the same time, rotate the setting knob until the green needle on the meter indicates the desired high limit cutoff temperature.
4. Release the push button and close the door.

START THE SYSTEM:

1. Energize the line voltage supply to R7161C.
2. Energize line voltage power to the load, including any starting interlocks or related equipment.
3. Depress and hold the PUSH TO RESET button on the R7161C (or remote reset switch if used) until the green lamp lights. This indicates that the load relay, K_1, has pulled in and closed the circuit to the external load through terminals 8-10.

R7161C ACTION DURING NORMAL PROCESS OPERATION:

With the controlled process operating, the green needle continually indicates the actual temperature sensed by the thermocouple. As long as the measured temperature is below the high limit setpoint, the meter face is lighted by the green lamp.

INDICATOR ACTION AT CUTOFF:

If the measured temperature reaches the high limit setpoint, relay K_1 drops out, breaking the external load circuit through terminals 8-10 (and closing the circuit through terminals 8-9). The red lamp illuminates the meter face and remains on until the instrument is manually reset, even though the temperature drops below the setpoint.

RESET AFTER CUTOFF:

The load relay locks out at the high limit cutoff temperature. It cannot be reset until the sensor input to the R7161 decreases by the equivalent amount of the relay differential, 40-120 microvolts.

Depress and hold the PUSH TO RESET button (or remote reset switch) until the green lamp lights. Remember: manual resetting is required after any shutdown, high limit condition or line voltage power interruption.

OPEN-CIRCUITED THERMOCOUPLE:

Thermocouple break protection is provided by range card resistor, r_5. In the event of an open sensor, the meter indicator drifts upscale from the setpoint. This simulates a high limit condition which immediately triggers a cutoff. Plugging the test cable (see CALIBRATION) into the jack gives the same effect, since it disconnects the external sensor circuit.

SHORT-CIRCUITED INPUT:

If the input terminals are shorted (or the test cable leads shorted), the R7161 indicates the instrument ambient temperature.

CALIBRATION AND ADJUSTMENT

IMPORTANT—

The R7161C is shipped completely factory calibrated and ready for operation when installed. However, the R7161C is designed to permit field changing of the control range. If the control range is changed, the R7161C must be recalibrated to the new range. Although this calibration is a field adjustment, it must be undertaken by QUALIFIED INSTRUMENT ENGINEERS ONLY.

CALIBRATION INSTRUMENTS

Use one of the following instruments for field calibration (or equivalent):

Rubicon Type 2745 or Type 2714 Portable Potentiometer

or

Brown Instrument Model 126W2P Portable Potentiometer

Honeywell #117053 Test Cable (see Fig. 6).

A. TO CHANGE THE RANGE CARD:

NOTE—The door and meter assembly should be replaced when the control range of the device is changed.

1. Turn off the power to the R7161.
2. Loosen the seven range card screws.
3. Replace the old range card with the new range card, and fasten it in position with the seven screws.

NOTE—If the new range card has a different range from the original, a new thermocouple may be required. (See SPECIFICATIONS).

B. TO CHANGE THE THERMOCOUPLE:

1. Turn off the power to the R7161.
2. Pull the two indicating lights out of their colored sleeves in the back of the door.
3. Remove the meter leadwire nuts and leadwires from the back of the meter.
4. If a different "TYPE" thermocouple is to be installed, remove the door screws at the hinge, and remove the door.

5. Remove the two chassis mounting screws, and disconnect the ten captive screws which serve as electrical connections between the chassis and the terminal strip.

6. Remove the chassis from the case.

7. Disconnect the thermocouple leadwires, and remove the old thermocouple.

8. Install the new thermocouple, and connect it to the plus (+) and minus (-) terminals, observing proper polarity.

9. Replace the chassis.

10. Start all ten captive screws. Then, tighten all ten screws individually. Next, install the two chassis screws.

11. Install the appropriate door and meter assembly.

12. Replace the meter leadwires, observing proper polarity of red on plus (+) terminal.

13. Snap the two indicating lights into position, observing the color coding tape on the lamp base and the plastic sleeve color.

C. AMBIENT TEMPERATURE COMPENSATION ADJUSTMENT:

1. Ambient temperature should be approximately 80 F.

2. Energize line voltage supply to R7161C.

3. Measure the millivoltage drop across range card resistor, second from left on range card. Top of resistor is (-), the bottom is (+).

4. Adjust potentiometer P_1 to obtain correct reading as listed below.

Thermocouple Type	Correct Reading	Tolerance
J	13.30 mv	± 0.40 mv
K	10.60 mv	± 0.40 mv
R	1.55 mv	± 0.15 mv

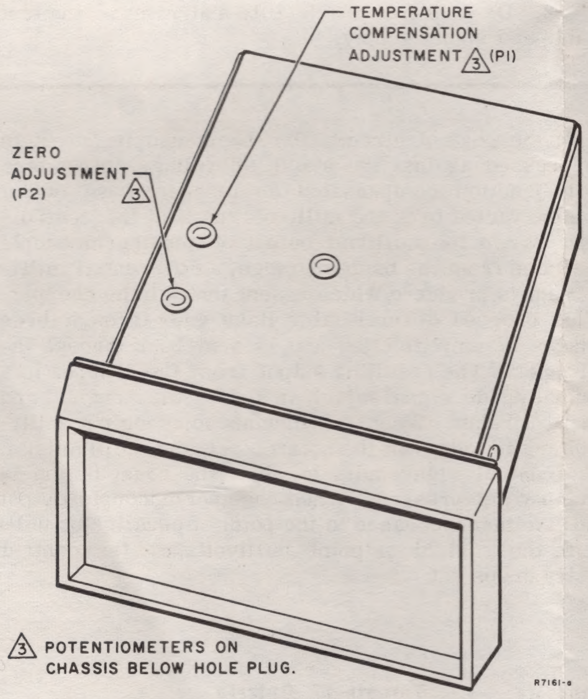

TEMPERATURE COMPENSATION ADJUSTMENT 3 (P1)
ZERO ADJUSTMENT (P2) 3
3 POTENTIOMETERS ON CHASSIS BELOW HOLE PLUG.
R7161-a

Fig. 5—Location of Access Holes for P_1 and P_2.

D. TO MAKE THE ZERO ADJUSTMENT (P_2)—with Rubicon Type 2745 Portable Potentiometer (or equal) and Honeywell #117053 Test Cable. See also ALTERNATE METHOD:

NOTE—These adjustments must be made with the chassis in a case. They need not, however, be made in the case in which the chassis is housed during normal operation. If a spare case is not available, the chassis must be returned to the original case for calibration. Be sure that the thermocouple is disconnected if the test cable is not used.

1. De-energize the R7161.

2. Check mechanical zero of the meter and correct if necessary.

3. Plug the #117053 Test Cable into the test jack.

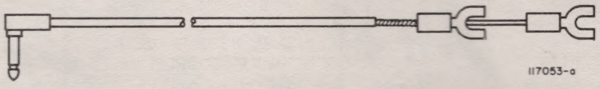


Fig. 6—Honeywell #117053 Test Cable.

4. Connect the portable potentiometer to the test cable leads, plus (+) to the black lead and minus (-) to the red lead.

5. If the calibration is to be performed with the chassis in its original case, mount the new door and meter assembly on the case next. However, if calibration is to be done on a test bench in a spare case, do not fasten the door and meter assembly on the spare case, but stand it in its normal position on the front of the case. This position is essential for accurate calibration because of the magnetic effects of the meter.

6. Connect the meter leadwires to the meter of the new cover assembly, observing proper polarity of red leadwire to the (+) terminal.

7. Turn the control point potentiometer counterclockwise until the potentiometer reaches the end of its mechanical adjustment.

8. Energize the R7161, and apply a millivolt signal equivalent to 0 F with case temperature allowance.

9. Remove the hole plugs from the top of the case.

10. Wrap the shaft of an insulated handle screwdriver with a layer of insulating tape to eliminate grounding during the calibration procedure.

11. Adjust the zero adjustment potentiometer (P_2) (see Fig. 5) until the R7161 meter reads 0 F.

E. TO MAKE THE SPAN ADJUSTMENT (P3)—with Rubicon Type 2745 Portable Potentiometer (or equal) and Honeywell #117053 Test Cable. See also ALTERNATE METHOD:

1. With the R7161 still energized, apply a millivolt signal equivalent to full scale temperature with case temperature allowance.

2. Depress PUSH TO SET button and turn setpoint knob until the meter indicates exactly full scale span.

3. Release the PUSH TO SET button and adjust the span adjustment potentiometer (see Fig. 2) until the meter indicates exactly full scale span.

4. Press the PUSH TO SET knob to verify that identical position occurs with the knob alternately pushed in and released. If not, repeat steps 2 and 3.

5. De-energize the R7161, and remove the test cable and signal supply.

F. ALTERNATE METHOD FOR ZERO AND SPAN CALIBRATION:

This procedure, although more difficult to set up, is very similar to factory methods and produces more accurate results than the previously outlined procedure. It differs mainly in the method of applying the simulated temperature signal (see Fig. 7). It is recommended that the entire preceding calibration procedure be read before using this alternate method.

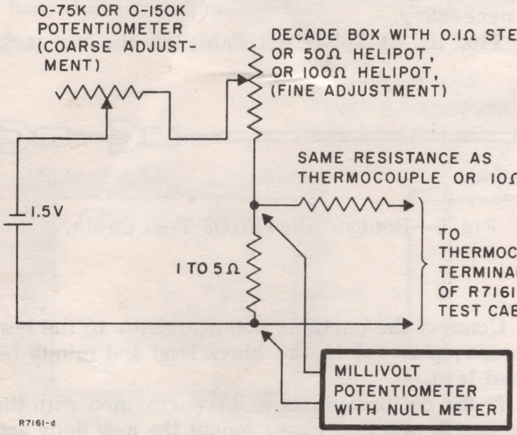

0-75K OR 0-150K POTENTIOMETER (COARSE ADJUSTMENT)
DECADE BOX WITH 0.1Ω STEPS, OR 50Ω HELIPOT, OR 100Ω HELIPOT, (FINE ADJUSTMENT)
SAME RESISTANCE AS THERMOCOUPLE OR 10Ω
1.5V
1 TO 5Ω
TO THERMOCOUPLE TERMINALS OF R7161 OR TEST CABLE
MILLIVOLT POTENTIOMETER WITH NULL METER
R7161-d

Fig. 7—Special Calibration Circuit.

Procedure—

1. With the Honeywell #117053 Test Cable plugged in and the test circuit connected plus (+) to black and minus (-) to red, power the R7161 chassis.

2. Temporarily attach a millivolt potentiometer with a null meter across the 1 to 5-ohm resistor in the test circuit, and set the potentiometer for 0 F with case temperature allowance.

3. Adjust the variable resistances until the millivolt potentiometer shows null. This means that the voltage across the 1 to 5-ohm resistor is the same as the desired voltage. Disconnect the millivolt potentiometer.

4. Turn the knob of the control point potentiometer counterclockwise until the potentiometer reaches the end of its mechanical adjustment.

5. Remove the hole plugs from the top of the case. Wrap the shaft of an insulated handle screwdriver with a layer of dielectric tape to eliminate grounding during the calibration procedure.

6. Adjust the zero adjustment potentiometer, P_2 (see Fig. 5), until the R7161 meter reads 0 F.

7. Depress the **PUSH TO SET** button and turn setpoint knob until the meter indicates exactly full scale span.

8. Connect the millivolt potentiometer and adjust it to give a full scale reading (with case allowance) as indicated by the calibrated scaleplate.

9. Adjust the variable resistances until the millivolt potentiometer shows null. This means that the voltage across the 1 to 5-ohm resistor is the same as the desired voltage. Disconnect the millivolt potentiometer.

10. Adjust the span adjustment potentiometer (see Fig. 2) until the meter on the R7161 indicates full scale span. Be careful not to ground the potentiometer to the chassis with the screwdriver during this operation.

11. Press the **PUSH TO SET** button to verify that identical position occurs with the knob alternately pushed in and released. If not, repeat steps 7 through 10.

12. De-energize the R7161, and remove the test cable and signal supply.

CIRCUIT DESCRIPTION

The R7161 is a solid state, high limit controller that provides for on-off control action, utilizing a thermocouple millivoltage signal.

The R7161 consists of a stable dc bridge with variable output powered from a zener diode constant voltage source, a two-stage amplifier with an indicating meter, a three-stage amplifier, a chopper, trigger, and control relay. These functions are interconnected by two separate and independent circuits, the indicating circuit and the controlling circuit.

In the indicating circuit, the millivolt output from the thermocouple is sent through part of the bridge and on through the chopper. The chopped dc signal then goes through two stages of amplification and is sent back through the chopper. The resulting output from the chopper is a pulsating dc signal, the average of which is indicated on the meter as degrees of temperature.

In the control circuit, the thermocouple output is impressed against the stable dc voltage output of a cold-junction compensated dc bridge whose output can be varied over the millivolt range of the controller. When the millivolt output of the thermocouple deviates from the bridge voltage, a differential millivoltage is produced which is sent through the chopper. This chopped differential voltage goes through three stages of amplification and is sent back through the chopper. The resulting output from the chopper is a pulsating dc signal which is fed to the trigger and control relay. When the thermocouple output millivoltage is less than the control setpoint millivoltage, the control relay pulls in when the reset button is manually depressed. When the thermocouple output millivoltage increases to the point of equality (or null) with the control setpoint millivoltage, the control relay drops out.